Proceedings of the Iowa Academy of Science

Volume 78 | Number 1-2 Article 14

1971

Movement of Bigmouth Buffalo in Coralville Reservoir, Iowa

Larry Mitzner
Iowa Conservation Commission

Movement of Bigmouth Buffalo in Coralville Reservoir, Iowa[1]

LARRY MITZNER[2]

LARRY MITZNER. Movement of bigmouth buffalo in Coralville Reservoir, Iowa. *Proc. Iowa Acad. Sci.*, 78(1): 34-35, 1971.
SYNOPSIS. Movement characteristics of bigmouth buffalo were determined and used to correct for error in population estimates caused by dilution effect. No gross upstream or downstream movement was observed and one standard deviation of movement from point of release was 1.13 miles based on 60 recaptures. A total of 8,065 individuals were marked. I estimated 81% of the marked fish remained in a four mile study area during the investigation. Models are presented to determine movement and dispersion of marked fish from point of release.
INDEX DESCRIPTORS: bigmouth buffalo, movement, Coralville Reservoir

Bigmouth buffalo have potential industrial and commercial food value in waters where commercial gear is now statutorily prohibited. A knowledge of their life history and dynamics in inland waters must precede the biological eavluation of a commercial fishery. An important aspect of the life history investigations included the establishment of movement characteristics and patterns. Ancillary information from the study was also used to account for inaccuracy of population estimates which were conducted during the investigations in 1969. Movement of marked buffalo from a sampling area with inverse movement of unmarked buffalo would dilute the available marked population causing the estimate to be higher than actual.

Coralville Reservoir is a 4,900 acre flood control impoundment located on the Iowa River in Johnson County, Iowa. Physical and chemical description and operation of the reservoir have been described by Mayhew (1964).

METHODS AND PROCEDURES

All sampling was conducted in a study area 10 miles in length with further subdivisions of one mile. Segments were numbered consecutively from downstream to upstream. The lower boundary of the study area was located six miles upstream from the dam. The area involved contained 1,979 surface acres at elevation 680' msl and characteristics in the area were representative of the entire pool.

Fish were marked only in segments 4, 5, 6 and 7. In segments 4 and 5 they received a left pelvic fin clip and in segments 6 and 7 the right pelvic fin was clipped. Additional netting effort was extended in segments 1-3 and 8-10 to determine the dispersal of marked fish from areas 4-5 and 6-7.

Marking, capture and recapture were concurrent from 8 April through 12 August. Records were made of number caught, recaptured, origin of each recapture, and number marked and released for each segment on each day. Three assumptions were necessary: (1) marked fish in each segment had identical movement characteristics; (2) marked fish in any segment were caught as readily as in other segments; and (3) movement remained constant through the experiment.

Recaptured fish were classified by distance from point of release. Possible intervals were upstream 1-5 miles, downstream 1-3 miles and no movement for fish in segments 4 and 5. Classification of right-marked recaptures were 1-3 miles upstream, 1-5 miles downstream and no movement. The data were similar for both marking areas, and distribution was established by combining left-marked recaptures in segments (s) with right-marked recaptures in segments (s+2) where s represents any segment from 1-10.

RESULTS

Of 8,065 bigmouth buffalo marked during the experiment, 60 were recaptured. The recaptures were distributed so that 46 remained in the 4-mile area, 9 fish moved upstream and 5 downstream. Mean movement was 2.0 miles upstream and 1.4 miles downstream. The distribution was nearly normal except it was slightly skewed in the upstream direction. Standard deviation was 1.13 miles.

Using the standard deviation it was possible to estimate the probability (P_n) of a fish remaining within a given distance (n) from point of mark and release by the equation

$$z = \frac{n - m}{s_d}$$

where z = unitized distance from mean of a standard normal curve

n = distance under consideration from the mean of the empirical distribution

m = mean of the empirical distribution

s_d = standard deviation of the empirical distribution.

The equation was solved for z and the area under the normal curve (P_n) was determined from tables in which the relationship between z and P_n have been computed (Alder & Roessler, 1960).

The probability of any left-marked buffalo remaining in segment 4 (P_1) was 0.312 and of any left-marked individual remaining in 4 and 5 (P_2) was 0.624. Similar computations were made for the marking area plus two and four adjoining segments. Probability (P_4) of a buffalo remaining in the marking area or two adjoining segments was 0.923 and (P_6) was 0.992. The probability of a buffalo being captured more than three miles from point of release was 0.008.

[1] Contribution of Project 4-11-R, Commercial Fisheries Research and Development Act, State Conservation Commission and National Oceanic and Atmospheric Administration, National Marine Fisheries Services, Department of Commerce cooperating.

[2] Fisheries Research Biologist, Iowa Conservation Commission, Des Moines, Iowa 50319.

To correct for loss of marked fish from the study area in a population estimate the following equation was used

$$\sum_{i=1}^{s} N_i \, 0.5 \, [P_a + P_b] = \hat{N}$$

where P_a = probability of left-marked fish not going downstream farther than segment 4
P_b = probability of left-marked fish not going upstream farther than segment 7
N_i = number of fish marked in the ith segment
$\hat{N}$ = number of marked fish remaining in (s) segments
s = number of segments being examined and
i = any (s) segment being considered.

Empirical determination of $N_1, N_2, \ldots\ldots, N_s$ showed a relationship such that when i=1 and s=10 then $P_a=P_1$ and $P_b=P_{19}$; when i=2 and s=10 then $P_a=P_3$ and $P_b=P_{17}$. From this series of arithmetic progression the subscripts a and b were replaced by 2i-1 and 2s-(2i-1) and the equation was rewritten

$$\sum_{i=1}^{s} N_i \, 0.5 \, [P_{2i-1} + P_{2s-(2i-1)}] = \hat{N}$$

In this experiment segments 4 and 5 were considered as one unit with segments 6 and 7 the other unit; in all calculations s=2. The percentage of marked buffalo remaining in segments 4-5 was

$$100(0.5)\,[0.624 + 0.992] = 80.8$$

and the same was true for segments 6 and 7 because of the symmetry in the study area.

Dilution of marked bigmouth buffalo occurred from movement past the outer boundaries of segments 4 and 7. Fish bearing right marks decreased 0.4% due to movement past segment 4 and 18.8% from movement past segment 7. Conversely, fish with left marks decreased 0.4% from movement past segment 7 and 18.8% moved past segment 4.

Buffalo marked for movement studies were also used as a sub-population from which recaptures were sampled to determine population estimates. Fish were marked and captured continuously and estimates were made for individual census periods in addition to cumulative estimates. Cumulative estimate in the final census period with correction for movement of the marked population was 366 per acre with 95% confidence limits of 281 to 526 per acre. If correction for movement had not been accounted for, the estimate would have been 439 buffalo per acre or 19% higher than that of the corrected estimate.

ACKNOWLEDGMENT

The author is grateful to James Mayhew for manuscript review and Joseph Golden for field assistance.

LITERATURE CITED

ALDER, H. L., & E. B. ROESSLER. 1960. *Introduction to probability and statistics*. W. H. Freeman & Co., San Francisco, 289 p.

MAYHEW, J. 1964. Coralville Reservoir fisheries investigations 1963. Part II. Limnology and fish populations. *Quart. Biol. Rpts., Ia. Cons. Comm., 16*(1): 25-31.